Leech predation of frog spawn

Introduction

The predators of Australian anurans and their larvae are well documented (Tyler 1976, 1994, Littlejohn and Wainer 1978; Davies *et al.* 1979; Morgan and Buttemer 1996, Gillespie and Hero 1999). By contrast, little has been published on the sources of predation of their spawn. Tyler (1976, 1994) states that there are relatively few predators of frog spawn and that 'fish probably constitute the major predator'. He notes in particular that the foam nests of the genus *Limnodynastes* are probably most accessible to terrestrial insects because they tend to be located around the edges of ponds where they are attached to peripheral vegetation, and that they are occasionally eaten by ants. Members of the Australian frog genus *Limnodynastes* produce floating foam-capped nests below which the egg mass resides (Parker 1940; Tyler and Davies 1979; Roberts 1989). One member of this genus, the Spotted Marsh Frog *Limnodynastes tasmaniensis*, is a very common species throughout much of south-eastern Australia where it breeds in most months of the year in both temporary and permanent water bodies and in a wide variety of both natural and man-made habitats (Barker *et al.* 1995; Hero *et al.* 1991; Littlejohn 2003). Herein I report the predation of *L. tasmaniensis* spawn by leeches in an ephemeral wetland near Melbourne some 25 years ago and compare these observations with a very similar report of predation documented by Burgin and Schell (2005) in the Sydney area.

Observations

1. On 6 January 1987, following two days of heavy rain, a shallow ephemeral wetland located in remnant River Red Gum *Eucalyptus camaldulensis* woodland adjacent to the Darebin Creek in the north of Bundoora (37°69'S, 145°05'E) Victoria, was visited. The swamp had been completely dry since about mid-December of the previous year but rain had refilled it and had stimulated a burst of breeding activity in *L. tasmaniensis*. There were large persistent daytime choruses (> 50 males) and numerous freshly deposited foam nests around clumps of aquatic vegetation. Most nests were aggregated amongst a 9 m^2 patch of Spikerush *Eleocharis sphaecelata* where they were exposed to dappled sunlight or else were completely shaded. A total of 27 nests were located in this patch. The site was visited over four consecutive days and nests inspected for the presence of leeches and other invertebrates on each occasion. Water temperature approximately 10 cm below the surface varied between 21–24°C at midday over the four days.

   Leeches were observed on the foam caps of *L. tasmaniensis* nests on each day. All of the leeches appeared to belong to the same species and were uniform black in colour and approx. 50–60 mm in length. (Leeches were not able to be identified to genus (or species) level owing to the lack of an appropriate identification guide at the time.) The leeches were observed typically lying completely still on the foam cap of the nests with the head and anterior body buried down through the foam cap into the gelatinous egg mass below. While most of the affected nests contained a single leech, on three nests there were two, and on one nest, three leeches. On three nests the surface of the foam caps had dried to a polystyrene-like consistency and leeches had attached themselves to the side of the nest where they were just visible above the water line. Nests around the periphery of the aggregation were most affected by leeches while only one leech was recorded on a nest near the 'centre'. On the first day, three of the leeches (taken from nests outside of the aggregation) were euthanised and found to contain numerous (> 10), mostly intact frog's eggs.

   The incidence of leeches on foam nests remained fairly constant over the four days, affecting about one-third of all nests (30–37%;

Table 1). By the fourth day, the eggs of seven nests had begun to hatch and most of the others were close to hatching (Gosner stages 20–25; Duellman and Trueb 1986). Two nests were occupied by leeches for up to three consecutive days. Eight leeches closely examined on the fourth day had noticeably distended bodies, indicating recent feeding.

Other arthropods located on the foam caps of nests included (total number in parenthesis): ants (6), aquatic snails (5), spiders (4), caterpillars (3), millipedes (2) and dipterans (8). As none of these arthropods appeared to be feeding directly on the eggs, it is likely that these occurrences were quite incidental and represent fauna displaced by flooding (although see Discussion). The percentage of nests with other arthropods was consistent over the three days they were recorded (14–16%; Table 1).

In addition to the observations above, I have since made very similar observations at two other (nearby) sites:

2. Approximately 3 km south of the above site, beside the Darebin Creek in Bundoora, two leeches were located on separate, recently deposited *L. tasmaniensis* nests in a relatively small ephemeral pond following rain in January.
3. At Somerton (37°63'S, 144°95'E) near the southern boundary of Craigieburn Grasslands, four leeches were located separately on the foam caps of freshly laid *L. tasmaniensis* nests partially concealed by *Poa* sp. tussocks and deposited in a large ephemeral pond which had been filled by heavy rain in November.

At all three localities the leeches found on *L. tasmaniensis* nests appeared to be the same species. These leeches were occasionally caught in dip-nets skimmed through water around the periphery of large ponds and swamps at the sites, indicating their aquatic habit. While *L. tasmaniensis* has frequently been observed to breed in small ephemeral ponds ($n > 15$), no leeches were ever observed on nests deposited in these ponds. Leeches were never observed as ectoparasites of *L. tasmaniensis* larvae or adult frogs at any of the sites, despite regular visits over more than ten years.

Discussion

The sanguivorous habit of many terrestrial and aquatic leeches is well known and leeches have been documented as ecto and endoparasites of both frogs and their larvae (Waite 1925; Mann and Tyler 1963; Brockelman 1969; Tyler 1976; Duellman and Trueb 1986; Sawyer 1986 and references therein; McCallum *et al.* 2011). By contrast the literature on leeches as macrophagous predators of frog spawn, though relatively small, has been largely neglected or omitted entirely from consideration in reviews of both leech and amphibian biology (Duellman and Trueb 1986; Govedich 2001; Toledo 2005; Romano and Di Cerbo 2007). A relatively recent literature review by Romano and Di Cerbo (2007) found that anuran egg predation by leeches had been documented in some 20 species, representing 3.6% of the total number of anuran species in those regions where anuran leech predation occurred. That some leech species should consume frog spawn is curious

Table 1. The frequency of occurrence of leeches and other arthropods on 27 foam nests of the Spotted Marsh Frog *Limnodynastes tasmaniensis* monitored over a four day period.

Day	Number of Leeches	% of nests with Leeches	% of nests with other arthropods
1	11	30	15
2	15	37	16
3	16	37	14
4	10	33	–

because it occurs in spite of a clear adaptation they have to piercing the skin of mammals (Cargo 1960) and other vertebrates. *Limnodynastes tasmaniensis* is the only Australian frog species in which this kind of predation has been documented to date.

The presence of leeches on *L. tasmaniensis* nests is unlikely to be the result of their displacement due to flooding for two reasons: (i) I had only ever located them in water and thus their presence on the top or sides of foam nests above the water level (in many instances) is at odds with this habit, and (ii) in all instances the head of the leech was protruding down through the foam cap into the egg mass, consistent with their being engaged in feeding. Even if the leeches were present on foam nests due to disturbance of some kind, the small sample of leeches found to have consumed frog spawn indicates opportunistic feeding was occurring. The number of leeches recorded on individual foam nests in this work must, however, be considered an underestimate as only a few nests were thoroughly examined for leeches residing amongst the egg mass or the portion of the egg mass below the water (and none were located).

The impact that the leeches had on individual nests was not apparently severe since their presence did not seem to affect the integrity of the nests and the relatively warm conditions meant that egg development was rapid, ensuring that most eggs hatched to produce larvae.

The occurrence of dipterans on nests, while possibly incidental, is worthy of closer examination as the parasitisation of frog spawn by dipteran larvae has been documented to occur in various other anuran species (Bokermann 1957; Tyler 1976; Villa *et al.* 1982; Menin and Giaretta 2003). Furthermore six South American leptodactylidae frog species (that produce foam nests similar to *L. tasmaniensis*) were found to suffer significant predation from dipteran larvae (Menin and Giaretta 2003).

It seems remarkable, given how common *L. tasmaniensis* is in south-eastern Australia, and the conspicuousness of black leeches on the contrasting white foam nests, that leech predation had not been reported until relatively recently. This may indicate that leech predation does not occur in all breeding situations, or is limited by the distribution and/or habitat preferences of the particular species of leech involved.

Burgin and Schell (2005) reported the leech *Bassianobdella fusca* feeding on *L. tasmaniensis* foam nests from a wetland near Sydney and most of the observations described above are consistent with their work. For instance, the timing of the observations in both cases was summer (or late spring), coinciding with maximum leech activity, and both sets of observations occurred in large ephemeral water bodies. One notable point of difference was that Burgin and Schell (*op. cit.*) observed that leeches consumed ova only in Gosner stages 1–14, which meant that clutches were vulnerable to predation only in the first 24 hours following oviposition; observations in this work indicate that leeches remained on spawn clumps, apparently continuing to feed, for up to four days. It would be useful to know if this same leech species was also responsible for predation events described in this work, and further, whether leeches are able to consume larger and more developmentally advanced larvae (i.e. Gosner stages > 14).

Finally, Håkansson and Loman (2004) have shown that spawn located in the centre of communal aggregations of the Common Frog *Rana temporaria* suffered markedly less leech predation compared to those on the periphery. A similar pattern of leech predation was noted in this work and may be worthy of more detailed examination.

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One Hundred and Twenty-two Years Ago

Notes On The Planarian Worms Obtained On The Upper Wellington.

BY ARTHUR DENDY

1. *Geoplana howitti*, species nova.—Unfortunately only a single specimen of this worm was found, but it is a well marked and very beautiful species. The ground colour of the dorsal surface is yellowish white. In the middle line there is a fairly broad band of the ground colour, and on each side of this a stripe of about equal width of dark purplish brown, then a rather broader band of ground colour thickly flecked with dark purplish brown and edged on the outside by a fine line of the same. Outside this is a very narrow margin of ground colour. All the dark bands unite at each end. The ventral surface is pale yellowish white or grey, with no markings.

2. *Geoplana lucasi*, Dendy.—This is a remarkable and very rare planarian, of unusually large size, and with black and white markings. It was hitherto known only from three specimens found on the top of the coast ranges in the Croajingolong district, on the occasion of the Club's expedition to that locality, and described (from spirit specimens only) by me in the " Transactionsof the Royal Society of Victoria." Only a single specimen was found.

3. *Geoplana quadrangulata*, Dendy.—A small variety of this remarkable species was found in abundance. Hitherto it has only been recorded from Macedon, and in very small numbers.

4. *Geoplana frosti*, Spencer.—This species was recently discovered on the Club's expedition to the Yarra Falls, and is described by Professor Spencer in the "Transactions of the Royal Society of Victoria." We obtained one small specimen.

5. *Geoplana alba*, Dendy.—We obtained several fine examples of this common planarian.

6. *Geoplana sulplmrea*, Fletcher and Hamilton.—This species was common.

From *The Victorian Naturalist*, **VIII**, pp. 43–44, June – July, 1891